

AUTOMOTIVE TRANSMISSION**BACKGROUND OF THE INVENTION**

Field of the Invention

[0001] The invention concerns an automobile transmission with a closeable and separable clutch, which is a disk clutch, wherein the disk carrier exhibits, distributed about the disk-facing circumference of a cylinder segment, alternating axial grooves and axial projections, and which on one axial end is connected with a hub via a drive plate, and wherein for transmission of torque a rotationally fixed connection is established between the drive plate and the disk carrier via a slide-in or plug-in gear, in which radial teeth provided at the outer circumference or periphery of the drive plate engage in corresponding radial recesses in the disk carrier.

Description of the Related Art

[0002] Disk clutches of various design and arrangement are known, for example from DE 101 10 145 A1 and the therein disclosed patents and published applications. A disk clutch includes multiple annular disk shaped outer friction plates, which on their outer circumference are provided with radial outward directed teeth and therewith, axially slideably and fixed against rotation, are supported in the inwards facing axial grooves of a drum shaped outer disk carrier, and further includes multiple annular disk-shaped inner friction plates, which on their inner circumference are provided with radial inwards directed teeth and therewith are supported axially slideably and fixed against rotation in outward facing axial grooves of a cylindrical inner disk carrier. The outer and inner friction plates are arranged alternating axially and are bathed in an oil bath by the surrounding hydraulic fluid. By increasing the pressure of the hydraulic fluid the friction plates are axially pressed against each other, whereby the clutch is closed for the frictional transmission of torque between the outer disk carrier and the inner disk carrier. On the other hand, the disk clutch is opened by the reduction or removal of pressure of the hydraulic fluid.

- 1 -

EXPRESS MAIL LABEL NO. EV/330284/51045
I HEREBY CERTIFY THAT THIS PAPER IS BEING DEPOSITED WITH THE
UNITED STATES POSTAL SERVICE "EXPRESS MAIL POST OFFICE TO
ADDRESSEE" SERVICE UNDER 37 CFR 1.10 IN AN ENVELOPE ADDRESSED
TO: THE COMMISSIONER OF PATENTS, P.O. BOX 1480, ALEXANDRIA, VA
22313-1480, ON THIS DATE. THE COMMISSIONER IS HEREBY AUTHORIZED
TO CHARGE ANY FEES ARISING HEREFROM AT ANY TIME TO DEPOSIT
ACCOUNT 18-0877.

11-18-03
DATE

[Signature]
SIGNATURE

[0003] The following discussion is based upon a disk clutch, wherein the disk carrier exhibits, distributed about the disk-facing circumference of a cylinder segment, alternating axial grooves and axial projections, and which on one axial end is connected with a hub via a drive plate, and wherein, for transmission of torque, a rotationally fixed connection is established between the drive plate and the disk carrier via a slide-in or plug-in gear, in which radial teeth provided at the outer circumference of the drive plate engage in corresponding radial recesses in the disk carrier. The disk carrier could be either an outer disk carrier or an inner disk carrier, wherein the axial grooves serve respectively for receiving the disk teeth of the concerned disks or friction plates. In particular in the case of an outer disk carrier, due to the relatively large dimensions, both the disk carrier as well as the drive plate are for weight and cost reasons preferably made as sheet press and punch components. A plug-in gearing between drive plate and the disk carrier (clutch basket design) of a disk clutch is known for example from DE 101 18 233 A1.

[0004] According to the state of the art, this type of plug-in gearing is designed with axial play factored in, in order to allow for compensation for thermal expansion of the disk carrier and for axial movements of the drive plate as necessary during normal operation, for example in that the axial play of the teeth of the drive plate, as described in DE 33 21 659 A1, are bordered by a securing ring connected in or on the disk carrier or by other projections or protrusions of the disk carrier. In the context of an automotive transmission, in which the drive plate has the task of introducing the torque produced by the drive motor, in particular an internal combustion piston engine, into the disk carrier of a disk clutch acting as motor transmission, this existing axial play is however disadvantageous. Due to the manner of operation of an internal combustion piston engine

the produced torque is not produced evenly over all angles of rotation, but rather is a factor of the number and arrangement of the cylinders, peaking in correspondence with the expansion gas force in the individual cylinder combustion spaces. Additionally, the piston rod of the internal combustion piston motor is caused by the effective gas forces to undergo a periodic warping, which is transmitted to the input side of the transmission or, as the case may be, the preceding motor clutch, and results in a recoiling action of the drive plate. This recoil movement causes, in the case of a drive plate supported with axial play, an axial slippage between the teeth of the drive plate and the recesses of the disk carrier, whereby on the affected contact surfaces disadvantageously large frictional wear occurs which is associated with increased tooth flank play and increased development of noise.

SUMMARY OF THE INVENTION

[0005] It is thus the task of the present invention to improve the disk clutches of the above-described type, which are to be employed as components of an automotive transmission in particular as a motor clutch, in such a manner that the drive plate is axially supported in a space saving and economical mode and manner.

[0006] The problem is inventively solved in the context of the precharacterizing portion of patent claim 1 in that the drive plate is connected axially free of play with the disk carrier, in that the recesses of the disk carrier are in the form of axially open-ended clearances or cutouts, through which the first teeth (load teeth) of the drive plate project radially and lie against with their axial inner sides, and in that the disk carrier axially on its end includes a form-locking supported securing ring, against which second teeth (journal or bearing teeth) of the drive plate lie with their axial outer sides.

[0007] Advantageous embodiments of the inventive automotive transmission are set forth in the dependent claims 2 through 12.

[0008] By the design of the recesses as axially open-ended cutouts, which can be produced simply and economically by punching in the case of a disk carrier formed as a sheet press and sheet punch component, the drive plate can be assembled following assembly of the associated disks simply by axial sliding on, and then secured by seating or application of the securing ring. By the dimensioning of the axial separation of the axial inner walls of the cutouts to the axial inner side of the mounted securing ring according to the wall thickness of the drive plate or as the case may be the teeth there results in simple and space saving manner an axial connection free of play of the drive plate with the disk carrier, in which a torque is transmitted from the drive plate onto the disk carrier form-fittingly essentially via the load teeth and the peripheral or surrounding inner walls of the recesses. The inner axial supporting of the drive plate occurs likewise via the load teeth by the contacting or lying against of the axial inner sides of the load teeth against the concerned axial inner surfaces of the cutouts. The outer axial supporting of the drive plate occurs, in contrast, essential via the bearing teeth, by the contacting of the axial outer sides of the bearing teeth against the inner sides of the employed securing ring, which leads to a relief of the load on the load teeth.

[0009] In order to limit the axial dimensions of the disk clutch the cutouts are preferably respectively located centrally in the disk-facing axial projections of the disk carrier. Thereby it is accomplished that the load teeth can be designed to be sufficiently high without radial over-projection, in order to compensate reliably the expansion of the disk carrier diameter due to thermal expansion. This means that the load teeth do not radially project beyond, in

the case of an outer disk carrier, the outer contour, and in the case of an inner disk carrier, the inner contour, of the disk carrier. The disk carrier can be either a massive component (cast or mill component) or a sheet metal press and punch component.

[00010] For limiting the load or force on the drive plate, the bearing teeth are preferably comprised of two bearing tongues, which are preferably arranged and designed in such a manner, that they surround peripherally the side flanks of respectively one disk facing axial projection. Thereby on the one hand the load carrying cross-sectional surface of the bearing teeth is enlarged, reducing the load or force. On the other hand the bearing teeth or as the case may be bearing tongues can be used for the form fitting or engaging transmission of torque between the drive plate and the disk carrier via the form fitting or form locking contact with the flanks of the axial projections to supplement that of the load teeth. For limiting the load of the drive plate and the disk carrier, in particular for avoiding an axial end sided fissures which would adversely affect stability, the drive plate preferably exhibits no load teeth between the bearing tongues and the respective bearing teeth, and the disk carrier respectively exhibits no cutouts at the axial projections immediately adjacent the bearing tongues of the bearing teeth.

[00011] In a preferred embodiment of the disk clutch, for the even distribution of load and bearing forces the load teeth and the bearing teeth are alternately evenly distributed about the outer circumference or periphery of the drive plate. In particular it is proposed that the drive plate exhibits one bearing tooth respectively in the place of each third load or working tooth.

[00012] For simplification of the assembly of the drive plate and the securing ring the axial projections of the disk carrier provided for the two-sided alignment of the bearing

tongues are preferably elongated axially on the end and exhibit in the elongated area respectively a segment of an annular groove as appropriate for receiving the securing ring. In the case that the disk carrier is a massive component the annular groove can be produced in simple manner by machining. If the disk carrier is a sheet press and punch component the annular groove can in simple manner be made by the partial stamping and pressing in of appropriate segments of the axial projections of the disk carrier.

[00013] In a preferred embodiment of the disk clutch, the load teeth of the drive plate exhibit, for avoidance of tooth flank play due to thermal expansion, radially outwardly and on both sides respectively peripheral widenings with inner wedge surfaces, which in the case of a widening of the disk carrier are provided for lying against the circumference sided inner walls of the cutouts. Upon a warming up of the disk clutch during operation, and as a result of centrifugal forces due to increasing rotational speed, the disk carrier expands circumferentially and therewith also radially, which leads to a circumferential widening or expansion of the cutouts and in the case that substantially oblong or rectangular load teeth are used, leads to an undesired tooth flank play between the load teeth of the drive plate and the peripheral inner walls of the cutouts of the disk carrier. Since the drive plate expands less strongly upon heating than the disk carrier, there results during an operational heating up, when using the preferred embodiment of the load teeth, that the inner wedge surfaces of the load teeth come into contact with the peripheral side inner wall of the cutouts, whereby the tooth flank play is prevented to at least strongly reduced.

[00014] Mostly as a result of the assembly of the disk clutch by the axial alignment of the drive plate, manufacturing tolerances of the concerned components are compensated for or balanced out and an operationally associated necessary axial play of the disk is preset. This

can occur for example by the use of a securing ring which in multiple axis is of various thicknesses, which is however relatively cumbersome and expensive. It is thus substantially simpler and more economical when, for axial adjustment of the drive plate on the hub, the hub is provided with a recess with an outer cylinder surface and the drive disk is provided with a central bore with a corresponding inner cylinder surface, and the hub and the drive plate are welded to each other in an adjusted axial position in the contact area of the recess and the central bore.

[00015] The inventive disk clutch is preferred for the use as a motor clutch of an automated manual transmission, in particular however for use as a motor clutch of a double clutch transmission, since pressure controlled disk clutches are thermally highly loaded and the time sequences of the transmitted torque, in particular in the case of the control of the clutch transfer in a gear shift process of a double clutch drive, is particularly controllable. It is however also possible to use the inventive disk clutch as shifting element (shifting, coupling and/or shifting brake) of an automatic torque transfer.

BRIEF DESCRIPTION OF THE DRAWINGS

[00016] Further details of the invention can be seen from the following detailed description and the associated drawings, which serve as an example for explaining the inventive automotive transmission.

[00017] For this there is shown:

Fig. 1 a disk carrier of a disk clutch of an automotive transmission in perspective representation,

Fig. 2 a first embodiment of a drive plate of the disk clutch according to Fig. 1 with a hub and a securing ring in perspective representation,

- Fig. 3 a second embodiment of the drive plate of the disk clutch according to Fig. 1 with the hub and the securing ring in perspective representation, and
- Fig. 4 the disk carrier, the drive plate, the securing ring and the hub of the disk clutch according to Fig. 1 through 3 in assembled condition in a radial sectional view.

DETAILED DESCRIPTION OF THE INVENTION

[00018] A disk clutch **1** includes as components among other things a disk carrier **2**, a drive plate **3**, a securing ring **4** and a hub **5**.

[00019] The disk carrier **2** according to Fig. 1 is here in the form of a basket-shaped outer disk carrier **6** with an annular disk shaped base **7** and a cylinder-casing shaped cylinder segment **8**. The outer disk carrier **6** is a sheet press and punch part and exhibits on the cylinder segment **8**, distributed radially inside around the circumference, alternating axial grooves **9** and axial projections **10**. The axial grooves **9** are provided for engagement of radial outward teeth of multiple, not shown, outer disks and provided approximately centrally with openings **11** for radial flow-through of hydraulic fluid. The axial projections **10** exhibit in the area of their free end an overall circumscribing annular groove **12**, which is provided for receiving a not shown securing ring for limiting the axial play of the outer disks. Further, each first and second axial projection **10'** exhibits on its free end an open-ended cutout **13** with an axial inner wall **14** and, at the outer periphery, two inner walls **15**. Each third axial projection **10"** is extended or elongated axially on the end and exhibits in the elongated area **16** a segment of an annular groove **17**, which is provided for bearing or supporting the securing ring **4**. The annular grooves **12**, **17** are in the

present case produced respectively by partial radial punching in and out, or as the case may be, pressing of corresponding segments **18, 19** of the axial projections **10**.

[00020] In Fig. 2 a first embodiment of the drive plate **3** together with the hub **5**, and the securing ring **4** is shown. The drive plate **3** exhibits teeth **20, 21** on its outer circumference which are differentiated into load teeth **20** and bearing teeth **21**. Equally distributed over the outer circumference of the drive plate **3** are each first and second tooth as load teeth **20** and each third tooth as bearing teeth **21**. The load teeth **20** exhibit in axial view a substantially quadrilateral cross-section, are provided for engagement in the cutouts **13** of the disk carrier **2**, and serve essentially for transmission of torque between the drive plate **3** and the disk carrier **2**. The bearing teeth **21** are comprised respectively of two symmetric to each other shaped and positioned bearing tongues **22**, arranged adjacent the side flanks **23** of respectively one axial projection **10** and serve essentially for axially supporting of the securing ring **4**. By appropriate sizing and arrangement of the cutouts **13** and the annular groove **17** of the disk carrier **2**, the securing ring **4**, as well as the load teeth **20** and the bearing teeth **21** of the drive plate **3**, it is accomplished that the drive plate **3** in the assembled condition is connected axially free of play with the disk carrier **2**. The axial inner sides **24** of the load teeth **20** support themselves thereby radially inwardly against the axial inner walls **14** of the cutouts **13**, while the axial outer sides **25** of the bearing teeth **21** or, as the case may be, bearing tongues **22** support themselves against the axial inner sides **26** of the securing ring **4**. On the basis of the radial extension of the load teeth **20** through the cutouts **13** torque is transmitted between the drive plate **3** and the disk carrier **2** form fittingly by the contact of the outer peripheral flanks **27** of the load teeth **20** with the circumferential inner walls **15** of the cutouts **13**. The hub **5** exhibits outer teething **28**

for the drive side introduction of torque and a bearing shaft 29 for mounting in a drive-sided guide bearing.

[00021] In Fig. 3 a second embodiment of the drive plate 3' is shown together with the hub 5 and the securing ring 4. The drive plate 3' differs from the drive plate 3 according to Fig. 2 only by the different type of load teeth 20'. Here the load teeth 20' exhibit radially outwardly on both sides respectively the peripheral widenings 30 with inner wedge surfaces 31, which are provided for contacting against the circumferential inner walls 15 of the cutouts 13 in the case of a widening or expansion of the disk carrier 2. Following warm up during operation of the disk clutch 1 or on the basis of the centrifugal forces acting upon the rotating disk carrier 2 this expands circumferentially and therewith also radially, which leads to a circumferential expansion or widening of the cutouts 13 and, in the case of the use of substantially quadrilateral load teeth 20 according to Fig. 2, leads to an undesired tooth flank play between the load teeth 20 of the drive plate 3 and the circumferential inner walls 15 of the cutouts 13 of the disk carrier 2. Since the drive plate 3' expands less strongly upon heating than the disk carrier 2, there results, by employment of the load teeth 20' of the present embodiment according to Fig. 3, upon operational warming up, a contacting of the of the inner wedge surfaces 31 of the load teeth 20' with the circumferential inner walls 15 of the cutouts 13, whereby the tooth flank play brought about by thermal expansion and centrifugal forces can be prevented or at least strongly reduced.

[00022] In Fig. 4 the disk carrier 2, the drive plate 3, 3', the securing ring 4 and the hub 5 are shown in a radial sectional view in the assembled condition. It can be seen, that the hub 5 exhibits a step or shoulder 32 with an outer cylinder surface 33 and the drive plate 3, 3' exhibits a central bore 34 with a corresponding inner cylindrical surface

35. The drive plate 3, 3' can therewith be adjusted axially relative to the hub 5 by axial sliding 36 and these can be welded to each other in the axially adjusted position in the contact area 37 of the step or shoulder 32 and the central bore 34, which can be accomplished in the example by welding 38, preferably laser welding.

[00023] By the axial securing of the drive plate 3, 3' relative to the disk carrier 2 in accordance with the invention there is avoided, in a very space saving and cost effect mode and manner, axial slippage between the load teeth 20, 20' of the drive plate 3, 3' and the cutouts 13 of the disk carrier 2 during operation, and therewith there is avoided greater wear at the concerned contact surface, in particular between the circumferential flanks 27 of the load teeth 20, 20' and the circumferential inner walls 15 of the cutouts 13, which would otherwise have been associated with elevated tooth flank play and stronger development of noise.

Reference Number List

- 1 disk clutch
- 2 disk carrier
- 3 drive plate
- 3' drive plate
- 4 securing ring
- 5 hub
- 6 outer disk carrier
- 7 base
- 8 cylinder segment
- 9 axial groove
- 10 axial projection
- 10' (first, second) axial projection
- 10" (third) axial projection
- 11 opening
- 12 annular groove
- 13 cutout
- 14 axial inner wall
- 15 circumferential or peripheral inner wall
- 16 elongated area
- 17 annular groove
- 18 segment
- 19 segment
- 20 (first) tooth, load tooth
- 20' (first) tooth, load tooth
- 21 (second) tooth, bearing tooth
- 22 bearing tongue
- 23 side flank
- 24 axial inner side
- 25 axial outer side
- 26 axial inner side
- 27 circumferential or peripheral flank
- 28 outer teeth
- 29 bearing pin
- 30 circumferential widening
- 31 inner wedge surface

32 shoulder
33 cylinder outer surface
34 central bore
35 cylinder inner surface
36 axial displacement
37 contact area
38 weld